

BEST PRACTICE PROGRAMME

Good Practice Guide

16



A 3-boiler installation for a school

- a new generation of heating appliance
- suitable for most buildings, new or existing
- environmentally friendly (less CO₂ is produced)
- energy efficient (typically 15% less fuel)
- short payback period
- easy to install:-
DON'T need special radiators, systems or controls

GUIDE FOR

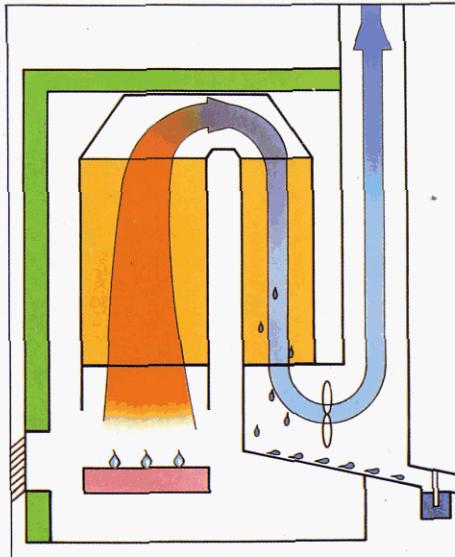
INSTALLERS OF

CONDENSING

BOILERS IN

COMMERCIAL

BUILDINGS



This Guide aims to highlight the key points of interest to installers of condensing boilers in commercial buildings. Increasing numbers of these boilers are likely to be installed now that there is growing concern for the environment and for energy efficiency. Running cost savings are also likely to prove increasingly significant.

Condensing boilers have been available since the early 1980's, and have been applied successfully in many buildings. Many of the early installations have now saved far more, in reduced running costs, than the initial capital cost premium.

Differences from conventional boiler installation practice are highlighted in this Guide. As well as boilers, condensing air heaters and hot water heaters now exist. Similar principles apply.

British Gas



HVCA



The Institute of Plumbing



Energy Efficiency Office
DEPARTMENT OF THE ENVIRONMENT

ARCHIVED DOCUMENT

CI/SFB 1976 32 R3 W8 Y7

CONDENSING BOILERS

The boiler

"Condensing boilers" are different from conventional boilers in that they have an additional or enlarged heat exchanger. This extracts more heat from the gases that pass up the flue, even when the boiler is not "condensing".

Waste gases leave the flue at low temperatures, around 40 to 80°C, compared to above 250°C in traditional boilers.

Water vapour is formed whenever gas is burnt. If the heat exchanger is cold enough, this water will condense on its surface.

Condensing boilers must therefore be plumbed to a drain, using PVC waste pipe. The condensate is slightly acidic (about the same as tomato juice or rainwater).

The main external differences

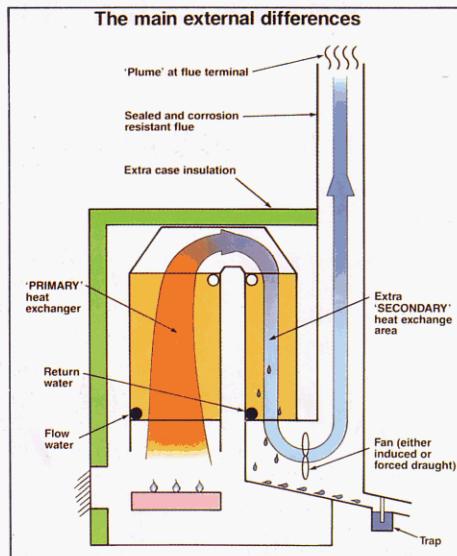


Figure 1

- Flue gases are at a low temperature, and in certain weather conditions can produce a visible "plume" of water vapour at the flue terminal.
- Materials used for the flue should be corrosion resistant. The flue needs to be well sealed at joints.
- The outside case of the boiler is normally very cool, resulting from good insulation, and so boiler rooms are likely to be colder.
- The boiler usually has an internal fan to assist the natural draught of the chimney.
- The boiler needs to be connected to a convenient drain location.
- Although the boiler has an additional or enlarged ("secondary") heat exchanger it need not be bigger overall, for the same output rating.
- The secondary heat exchanger is often internally connected to the "primary" giving single flow and return connections to the boiler (known as "integral") see Fig 2.
- They may also be piped separately (known as "split") see Fig 3.

Boiler Circuits

(a) Integral boiler

An "integral" condensing boiler, with no low temperature restriction, can be simply connected to the heating circuit.

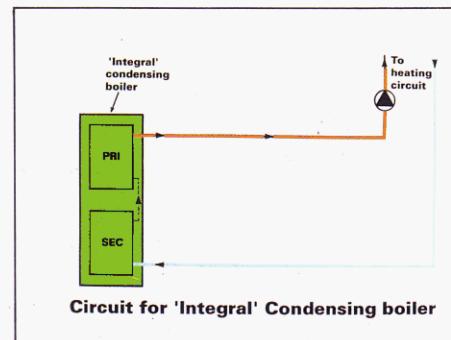


Figure 2

(b) Split boiler

A "split" condensing boiler, with separate heat exchanger connections needs to be connected via a three-way valve, but may offer greater flexibility by offering more circuit options, e.g. operating at different temperatures. (It may also be necessary to adopt this circuit if the manufacturer specifies a minimum temperature requirement for the primary heat exchanger i.e. back-end protection.)

Make sure the cooler (return) water flows through the condensing "secondary" heat exchanger first.

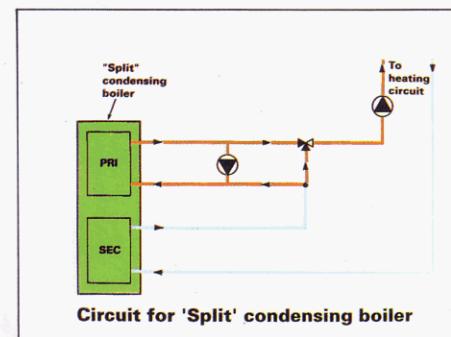


Figure 3

Condensing boilers are best used on "variable temperature" e.g. space heating circuits rather than "fixed high temperature". This is because boiler efficiency rises at lower temperatures. (See Fig. 4)

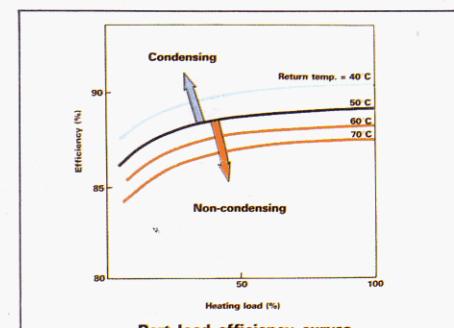


Figure 4

Controls

As required by the 1990 Building Regulations, weather compensation controls should be used to reduce system temperatures in mild weather. This leads to greatly improved efficiency because, for the majority of the heating season, the boiler will be in condensing mode. (See Fig 5).

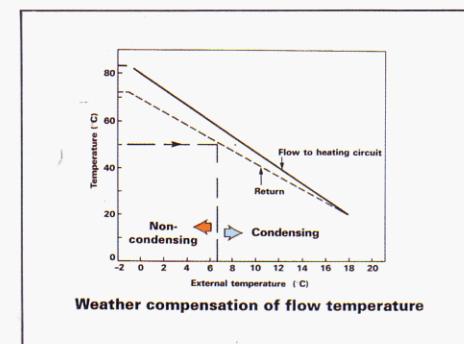


Figure 5

[Remember though, the boiler is only slightly less efficient when it is not condensing (Fig 4).]

Weather compensation can either be applied directly to the boiler (as is common with "integral" designs) or by way of a three way valve (as is with "split" designs.)

In general, the design of other controls, such as time control, optimum-start, boiler-sequence etc., should follow conventional good practice. It is seldom desirable or cost-effective to adopt more specialised control philosophies than would be used with conventional boilers, except perhaps on large schemes. However, it is important to check that controls operate as intended. The CIBSE Applications Manual: AM3 gives more detailed guidance.

Radiators/Emitters

There is no need to oversize either the boiler or the radiators beyond conventional margins for warm-up.

Oversized radiators give slightly higher efficiencies but the extra savings rarely justify the extra cost.

Design heat loss calculations, plus the appropriate margin, give the correct boiler output size required. **Do not oversize.**

Multi-boiler circuits

Frequently, multi-boiler installations are used to suit boiler-room space availability, to improve flexibility and back-up, or to suit available equipment.

Figure 6 (opposite) shows a schematic of a simple mixed multi-boiler circuit.

In a multi-boiler installation the lead boiler, (with the highest firing hours) takes most of the (low temperature) base load. This boiler, at least, should be a condensing type.

CHECK LIST OF KEY POINTS FOR CONDENSING BOILERS

The Boiler Room

- A source of clean air for combustion and ventilation is required, complying with BS6644. Air that is likely to be heavily contaminated from chemical processes e.g. paint spraying, dry cleaning etc must be avoided.
- A drain point is needed in or close to the boiler room. (A sump can be used in below-ground installations.)

Condensate Drainage Connection

- Install the drain connection in plastic or upvc pipe. This should have adequate rigid support and protection from damage.
- Joints must be well sealed and pipework must have a continuous slope down to the drain.
- Protection from freezing may be necessary if the drain pipe is exposed. Any blockage of the condensate drain can cause boiler shutdown, and could result in damage due to leakage.
- A U-trap is necessary on the boiler condensate outlet connection and on the flue drain (see manufacturers instructions).
- It is important to provide access for cleaning and inspection.
- An open "tundish" should be used, to allow the condensate to flow freely. This also allows the flow of condensate to be seen, as does a transparent U-trap.

Flue Connection

Stainless steel flues are usually required. Aluminium may be suitable for certain applications. Certain plastics may be permissible in future, since the flue gases are at such low temperatures.

- All joints in the flue system must be sealed

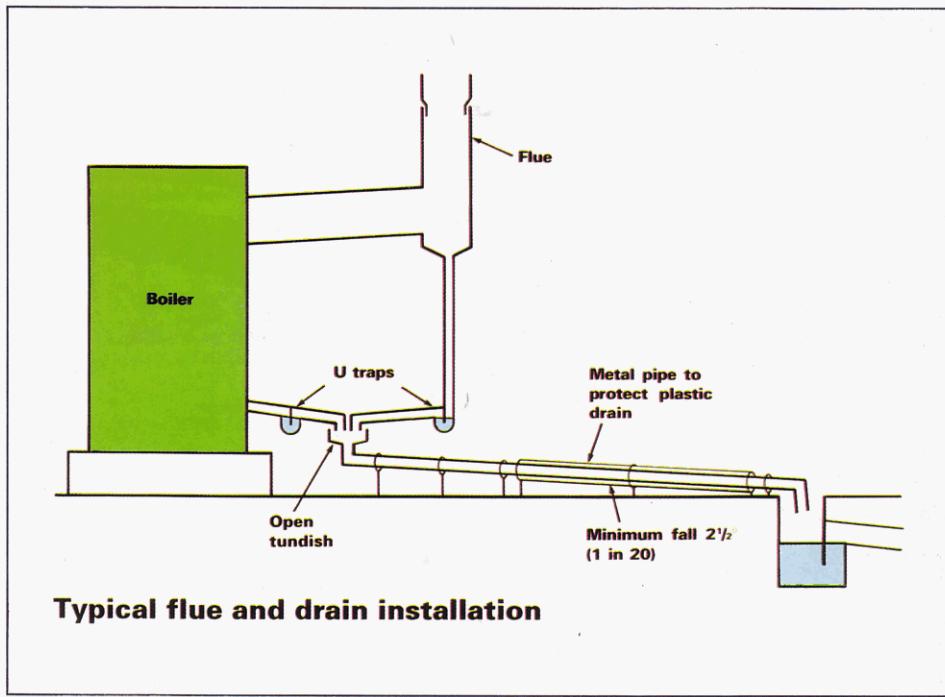


Figure 7

effectively (e.g. using a silicon rubber based sealant) — normally condensing boiler flues will be wet internally.

- Flue layout should be such that the condensate can flow freely downwards to a drainage point, which should be fitted with a U-trap.
- Crevices, or joints where condensate could collect must be avoided, and if socket joints are used these should be face upwards.
- Many manufacturers do not require the flue to be insulated.
- The location of the flue terminal needs to be carefully considered because of the visible "plume" that may occur. Avoid siting the terminal too close to air inlets, windows etc.

Avoiding Air in the System

- As with all modern boilers it is important to remove all air from the system water. Air vents should be provided at all high points to avoid any possibility of entrapped air.
- The positions of connections for open vent and cold feed in relation to circulating pump(s) are important. These should be such that air cannot be drawn into the system, and that water cannot be pumped over the open vent.

Strainers and Filters

- Include a strainer, or some other provision for filtering the heating system water, particularly if existing heating circuits are being retained i.e. boiler replacement only. (Some manufacturers insist on this provision.)
- The use of a large diameter header in the return leg, in which solid particles fall to the lowest point and can be drained, may be advantageous. This is also important if the boiler is of lightweight construction with narrow bore tubes.

Commissioning

- The full and proper commissioning of the boiler, the system, and the controls is essential to check that the installation works as intended.

Water Quality

To protect the materials that are employed for condensing boiler heat exchangers, the system water should be completely clean.

Some manufacturers specify a particular corrosion inhibitor, and no other type should be used. Use of the wrong inhibitor could lead to worse corrosion than with no inhibitor at all.

Figure 6

Schematic of a mixed multi-boiler circuit

CONDENSING BOILERS

The benefits

Over a full season, condensing boilers should burn at least 15% (and up to 30%) less gas than good new conventional designs, for the same heat.

When replacing old boilers, savings are commonly 40% of previous bills.

These savings arise from three separate factors:

- the extra heat recovered from the flue gas by the enlarged heat exchanger, occurring all the time the boiler fires (saving 5 to 10%)
- the "latent" heat recovered by the enlarged heat exchanger occurring whenever the boiler "condenses" (saving a further 5 to 10%)
- the design features that contribute to low standing losses, and hence high part-load efficiency, i.e. during mild weather (saving a further 5 to 30%)

The margin of efficiency over "high-efficiency" (non-condensing) designs is a little smaller.

See Figure 8.

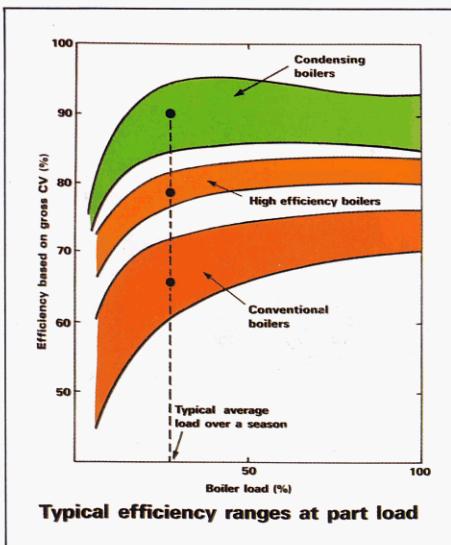


Figure 8

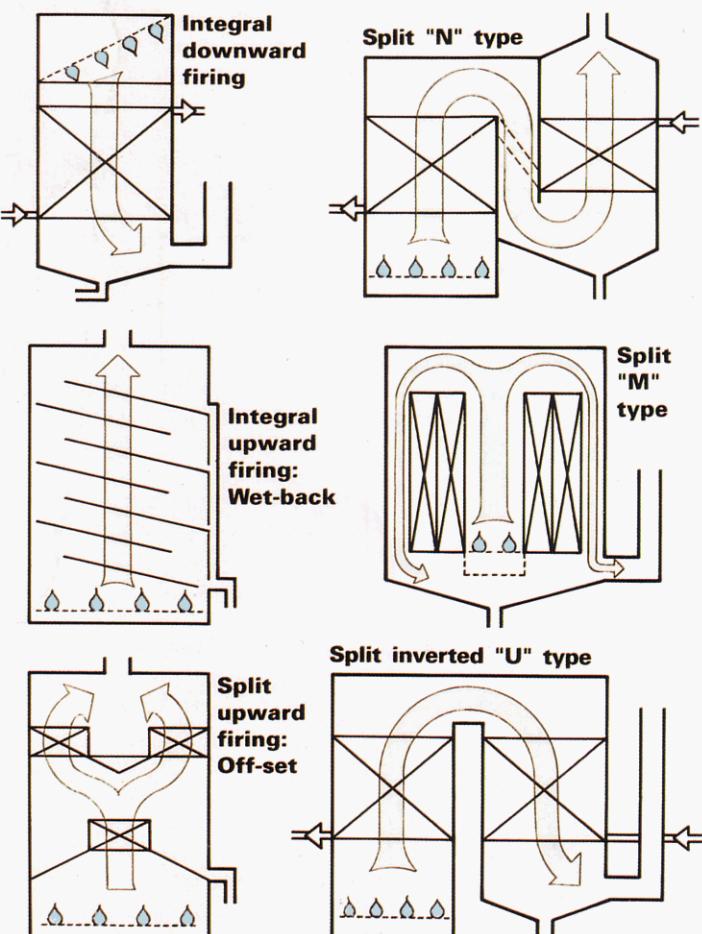
The economics

The economics of each case will be different.

BRECSU and British Gas case studies have shown short payback periods, down to below 1 year, in some applications. Payback of the added cost of the boiler within 3 years is commonly achieved.

As well as burning less fuel, the reduced emission of Carbon Dioxide (CO_2) by virtue of the improved performance, is the other major benefit of these boilers.

CO_2 is a major contributor to the "greenhouse" effect, and global warming.



Design configurations of available models

Publications

The Chartered Institution of Building Services Engineers (CIBSE) Applications Manual: AM3 on Condensing Boilers, gives further advice to designers, including appliance selection, new application yardsticks, system design and economic evaluation.

The British Gas publication "Guidance Note IM22" also gives installation advice and is available from British Gas.

As with all boilers, manufacturers' instructions must be followed.

Further reading

HVCA Energy Efficiency Handbook.

High efficiency condensing boilers; Office of Gas Supply, London SW1.

British Gas Guidance Notes for the Installation of Domestic Gas Condensing Boilers. Third Edition.

Acknowledgements:

BRECSU, on behalf of the Energy Efficiency Office, wish to acknowledge the contribution made by the Task Group involved in the production of this guide; the group comprised representatives from British Gas Watson House, CIBSE, HVCA and The Institute of Plumbing. This document is based on the best knowledge available at the time of publication.

Figure 9

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